# PATENT SPECIFICATION (11) 1221387

1221387

DRAWINGS ATTACHED

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## (54) FUSE CARTRIDGES


(71) We, LUCIEN FERRAZ & CIE, a French Joint Stock Company of 28, Rue Saint-Philippe, Lyon, Rhone, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—


The present invention relates to fuse cartridge units used for the protection of electric circuits or apparatus.

Such fuse cartridge units should support in continuous operation the full-load current of the apparatus which they protect and they should "blow" as soon as this apparatus is liable to be damaged by an overload. These conditions require in practice that the heat produced by the electric current which flows through the fusible element or elements of the cartridge unit may be easily dissipated.

It is an object of the present invention to provide a fuse cartridge unit wherein the heat generated by the electric current is the fusible elements may be dissipated more easily and more rapidly than heretofore.

Another object of this invention is to provide a fuse cartridge unit whose heat-dissipating characteristics are substantially similar to those of a cooled semiconductor device protected by the said cartridge unit.

According to the present invention there is provided a fuse cartridge unit comprising an insulating body having opposed major surfaces and having substantially parallel bores extending through the body to opposed ends thereof, fusible elements disposed in the bores together with arc-quenching material, and electrically conductive end plates disposed against the opposed ends and electrically connected with each other by the fusible elements, cooling devices each including a cooling plate applied in heat-conducting contact against a respective one of the major faces of the insulating body, and means for dissipating the heat which the cooling plates receive from the said body, one at least of the end plates being spaced from the cooling plates.


[*Price 5s. 0d. (25p)*]


The heat dissipating means may be formed of tubes or passages associated with or provided in the cooling plates and through which a cooling fluid is circulated, or of air-cooled fins carried by the cooling plates. In the case of a fuse cartridge unit intended to be mounted on a cooled current-carrying bar, the cooling plates may be integral with one of the end plates of the cartridge unit which end plate is to be applied against the bar, the end plate playing the role of the heat-dissipating means.

In order to reduce the resistance to the heat flow between the insulating body of the cartridge unit and the cooling plates, the major faces of the body are preferably metallized, the metallization terminating short of at least one of the opposed sides against which the end plates are applied, and the cooling plates are soldered to the metallized faces. The metal used for the metallization is preferably a fusible metal or alloy such as tin.

Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:

Fig. 1 is a side view of a twin fuse cartridge unit according to the invention, one of the elementary cartridges being illustrated in longitudinal section,

Fig. 2 is a front view of the unit of Figure 1 with parts in section,

Fig. 3 is a plan view of the unit illustrated in Figs. 1 and 2,

Fig. 4 is a horizontal section of a modified metallic cooling plate of the unit of Figure 1,

Fig. 5 is a perspective view of the insulating body of a fuse cartridge of the unit of Figure 1 before metallization of the major faces of the cartridge,

Fig. 6 is a longitudinal section of the insulating body of the cartridge of Figure 5 with the cooling plates soldered to the metallized faces,

Fig. 7 is a longitudinal section of a cartridge body equipped with cooling plates having air-cooled fins,

Fig. 8 very diagrammatically illustrates the

arrangement of the air-cooled fins in a twin fuse cartridge unit,

Fig. 9 is a side view of a fuse cartridge adapted to be carried by a cooled current-carrying bar, and

Fig. 10 is a plan view of the cartridge of Figure 9.

Referring to Figs. 1 to 3, a twin fuse cartridge unit is formed of two elementary cartridges, generally referenced A and B, disposed above each other, and of three cooling devices C, D and E associated therewith.

Each elementary fuse cartridge comprises a heat-resistant insulating body 1 (preferably made of a ceramic material of high heat conductivity) having the form of a relatively thick rectangular plate provided with three substantially parallel bores 1a of elliptical cross-section which extend through the body to opposed ends of the body 1, with the major axis of their cross-section parallel to the major faces of the body. A fusible strip 2 is disposed in each bore 1a, this strip being embedded in a mass 3 of a pulverulent arc-quenching material which fills the bore. As illustrated strips 2 are folded in rectangular zig-zag fashion, i.e. they comprise alternate upper and lower straight horizontal portions connected by short vertical portions. Each one of the ends of the strips is clamped between the corresponding side of body 1 and a respective one of two metallic end plates 4 each having a horizontally extending lug 5 adapted to form one of the terminals of the unit. As shown each end plate 4 extends horizontally across the full width of the unit and its height is such that it is common to the two elementary cartridges A and B. These end plates are suitably secured to body 1 of each elementary cartridge, as for instance by screws 6, body 1 being formed for this purpose with corresponding screw-threaded holes 1b (Fig. 1); )both end plates are spaced from the cooling devices.

The above-mentioned cooling devices C, D and E are respectively mounted on the upper face of elementary cartridge A, between the lower face of cartridge A and the upper face of cartridge B, and against the lower face of cartridge B. Each device comprises two copper cooling plates 7 and 8 between which is disposed a heat-dissipating copper tube folded on itself in the form of four parallel branches, the said tube being soldered to plates 7 and 8.

The whole unit is clamped by means of bolts 10.

In operation a cooling fluid, such as water, is circulated through tubes 9 in order to evacuate heat collected by the copper plates which are in contact with the major faces of the elementary cartridges (or more exactly of the insulating bodies 1 thereof). Since the resistance to the heat flow between the fusible strips and the major faces is relatively low owing to the small thickness of arc-quenching material interposed between each horizontal portion of the strips and the adjacent wall of the bores, and also to the small thickness of insulating material between this wall and the adjacent outer surface of body 1, the temperature of the strip does not rise dangerously in permanent operation under full nominal load. Moreover the heat-dissipating characteristics of the fuse cartridge unit may be similar to those of water-cooled semi-conductor devices with which such units may be associated.

Fig. 4 shows another embodiment of a cooling device for a fuse cartridge unit of the kind of Figs. 1 to 3. This device comprises a thick copper plate 11 in the thickness of which a number of longitudinal passages 11a (three in the example shown) have been drilled, these passages being connected by transverse passages 11b. By closing appropriate portions of these passages by plugs such as 12, it is possible to provide a single path for the flow of a cooling fluid between an inlet and an outlet.

It is of course important to realize a good heat-conducting contact between the major faces of the insulating body 1 of each elementary cartridge A or B and the corresponding cooling plate such as 7, for instance. This is preferably obtained by metallizing the major faces, as for instance by spraying thereon molten metal droplets by means of a metallizing pistol. For this purpose a protective covering 20 (Fig. 5) is first applied on each major face of body 1 in the vicinity of the sides thereof onto which the end plates 4 are subsequently to be secured. This covering is conveniently realized by wrapping an adhesive strip on body 1, the width a of this strip corresponding to the safe distance which is to be maintained between each cooling plate such as 7 and the adjacent end plate 4 for avoiding short-circuits. The exposed portion of each major face is then cleaned by sand-blasting and tin or another similar easily fusible metal or alloy is sprayed thereon in order to realize a first metallic layer 21 (Fig. 6) firmly attached to the insulating material. A copper plate 7 which has been carefully cleaned as required, is then applied against each layer 21 and it is heated up to the melting point of the metallic layer 21. The plate 7 is thus soldered to the metallized face of the insulating body. The heating operation may be effected in an appropriate oven, plates 7 (together with tubes 9 and plates 8) being maintained against body 1 by appropriate springs. During this soldering operation, owing to the presence of the strip or covering 20, no molten metal can flow toward the sides of the insulating body which will thereafter receive the end plates 4. The strips or coverings 20 are then removed and the fuse cartridge may be mounted in the usual way.

It is obvious that the metallization could be performed by means of any desired metal,

as for instance copper, the cooling plates being thereafter soldered to the metallic layer thus realized.

While Fig. 6 only shows a single fuse cartridge, it is obvious that the same procedure may be applied in the case of multiple cartridge units, as for instance to the twin unit of Figs. 1 to 3.

In the embodiment of Fig. 7 the cooling plates, here referenced 22, are provided with air-cooled heat-dissipating fins 23 which may for instance be soldered to plates 22. In a modification each plate 22 may be cast together with the corresponding fins 23.

In the case of a multiple fuse cartridge unit the facing fins 23a of the elementary cartridges may be interdigitated, as shown in Fig. 8, their number being preferably reduced with respect to the fins 23 of the outer cooling plates of the unit, as illustrated. As in the construction of Figs. 1 to 3 the unit preferably comprises a single pair of end plates for the insulating bodies 1A and 1B of both elementary cartridges.

In Figs. 9 and 10 the fuse cartridge is adapted to be mounted on a massive current-carrying bar 24 which is itself cooled in any appropriate manner, as for instance by inner water circulation as well-known in the art. The cooling plates 25 carried by the insulating body 1 of the cartridge are integral with one 26 of the end plates of the cartridge and this end plate is applied in heat-conducting contact against the current carrying bar 24. In the example illustrated the end plate 26 carries two screw-threaded rods 27 which are passed through holes provided in bar 24, their protruding ends receiving clamping nuts 28.

It will be understood that the heat collected by cooling plates 25 flows towards end plate 26 and is transferred to bar 24 from which it is evacuated by the cooling agent. Of course cooling plates 25 and end plate 26 should be thick enough for offering no appreciable resistance to the heat flow. It is also obvious that the cooling plates 25 could be realized in the form of separate parts soldered to the end plate 26.

The other end plate is spaced from the cooling plates.

WHAT WE CLAIM IS:—

1. A fuse cartridge unit comprising an insulating body having opposed major surfaces and having substantially parallel bores extending through the body to opposed ends thereof, fusible elements disposed in the bores together with arch-quenching material, and electrically conductive end plates disposed against the opposed ends and electrically connected with each other by the fusible elements, cooling devices each including a cooling plate applied in heat-conducting contact against a respective one of the major faces of the insulating body, and means for dissipating the heat which the cooling plates receive from the said body, one at least of the end plates being spaced from the cooling plates.

2. A fuse cartridge unit as claimed in claim 1, wherein the heat-dissipating means is formed by a tube in heat-conducting contact with the cooling plate of an associated cooling device and through which a cooling fluid such as water is circulatable.

3. A fuse cartridge unit as claimed in claim 1, wherein the heat-dissipating means is in the form of passages provided in the thickness of each cooling plate and through which a cooling fluid is circulatable.

4. A fuse cartridge unit as claimed in claim 1, wherein the heat dissipating means is in the form of air-cooled fins carried by each cooling plate.

5. A fuse cartridge unit as claimed in any one of the preceding claims, wherein the major faces of the insulating body are metallized, the metallization terminating short of one at least of the opposed ends of the body against which the end plates are applied, the cooling plates being soldered to the said metallized major faces.

6. A fuse cartridge unit as claimed in claim 1, intended to be carried by a cooled current-carrying bar, wherein the cooling plates are in heat-conducting relation with one of the end plates which is to be applied against the bar, said one end plate forming itself the heat-dissipating means for the cooling plates.

7. A fuse cartridge unit substantially as herein described and as illustrated in Figures 1 to 3 or Figures 1 to 3 as modified by Figure 4, Figures 5 and 6, Figure 7, Figure 8, or Figures 9 and 10 of the accompanying drawings.

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1221387 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

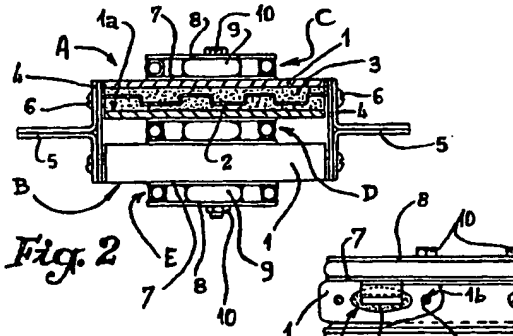


Fig. 2

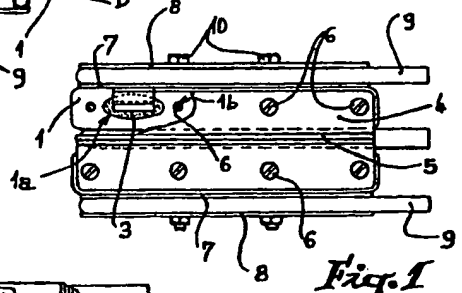


Fig. 1

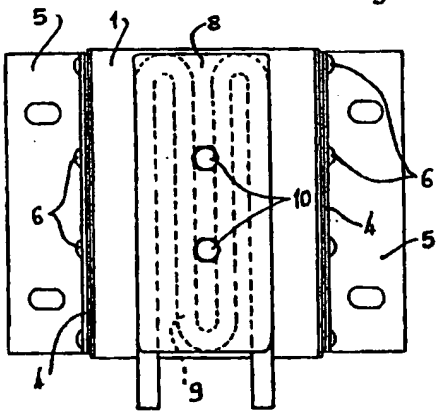


Fig. 3

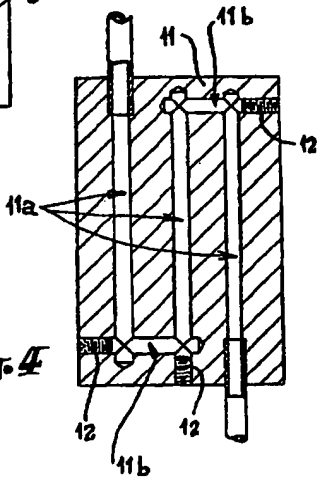


Fig. 4

1221387 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

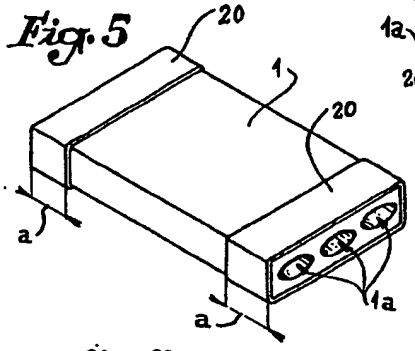


Fig. 5

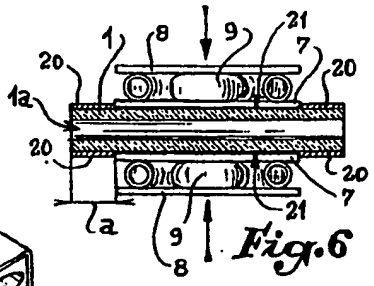


Fig. 6

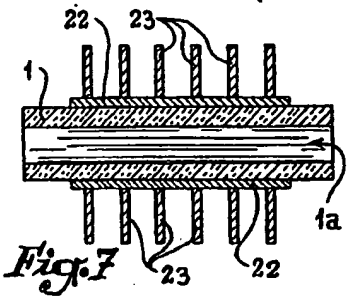


Fig. 7

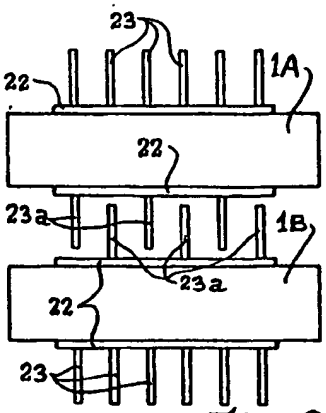


Fig. 8

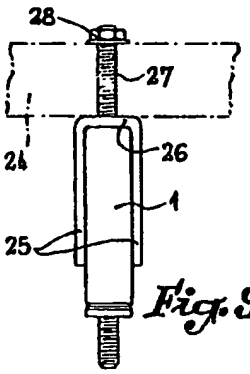


Fig. 9

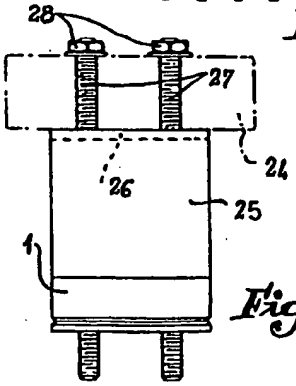


Fig. 10